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AEROFLEX

Ramp Test Set
NAV-402AP-3

Operation Manual

1002-0906-200
Issue-3

OPERATION MANUAL

RAMP TEST SET

NAV-402AP-3

PUBLISHED BY
Aeroflex

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Nomenclature Statement:

In this manual Test Set or Unit refers to the NAV-402AP-3 Marker, G/S, VOR, COMM and Auto Pilot Ramp and Bench Test Set.

Cable Statement:

For continued EMC compliance, all external cables must be 3 meters or less in length.

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SAFETY FIRST: TO ALL OPERATIONS PERSONNEL

REFER ALL SERVICING OF UNIT TO QUALIFIED TECHNICAL PERSONNEL. this unit contains no operator serviceable parts.

WARNING: USING THIS EQUIPMENT IN A MANNER NOT SPECIFIED BY THE ACCOMPANYING DOCUMENTATION MAY IMPAIR THE SAFETY PROTECTION PROVIDED BY THE EQUIPMENT.

CASE, COVER OR PANEL REMOVAL

Removing the Chassis Assembly from the Case Assembly exposes the operator to electrical hazards that can result in electrical shock or equipment damage. Do not operate this Test Set with the Chassis Assembly removed from the Case Assembly.

SAFETY IDENTIFICATION IN TECHNICAL MANUAL

This manual uses the following terms to draw attention to possible safety hazards, that may exist when operating this equipment.

CAUTION: THIS TERM IDENTIFIES CONDITIONS OR ACTIVITIES THAT, IF IGNORED, CAN RESULT IN EQUIPMENT OR PROPERTY DAMAGE (E.G., FIRE).

WARNING: THIS TERM IDENTIFIES CONDITIONS OR ACTIVITIES THAT, IF IGNORED, CAN RESULT IN PERSONAL INJURY OR DEATH.

SAFETY SYMBOLS IN MANUALS AND ON UNITS

CAUTION: THIS SYMBOL REFERS TO SPECIFIC CAUTIONS REPRESENTED ON THE UNIT AND CLARIFIED IN THE TEXT.

AC OR DC TERMINAL: TERMINAL THAT MAY SUPPLY OR BE SUPPLIED WITH AC OR DC VOLTAGE.

DC TERMINAL: TERMINAL THAT MAY SUPPLY OR BE SUPPLIED WITH DC VOLTAGE.

AC TERMINAL: TERMINAL THAT MAY SUPPLY OR BE SUPPLIED WITH AC OR ALTERNATING VOLTAGE.

SWITCH ON/OFF (PUSH-PUSH): POWER TO THE DEVICE IS CONNECTED ON OR DISCONNECTED OFF.

EQUIPMENT GROUNDING PRECAUTION

Improper grounding of equipment can result in electrical shock.

USE OF PROBES

Check specifications for the maximum voltage, current and power ratings of any connector on the Test Set before connecting it with a probe from a terminal device. Be sure the terminal device performs within these specifications before using it for measurement, to prevent electrical shock or damage to the equipment.

POWER CORDS

Power cords must not be frayed, broken nor expose bare wiring when operating this equipment.

USE RECOMMENDED FUSES ONLY

Use only fuses specifically recommended for the equipment at the specified current and voltage ratings.

INTERNAL BATTERY

This unit contains a Sealed-Lead Battery, serviceable only by a qualified technician.

CAUTION: SIGNAL GENERATORS CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE (EMI) TO COMMUNICATION RECEIVERS. SOME TRANSMITTED SIGNALS CAN CAUSE DISRUPTION AND INTERFERENCE TO COMMUNICATION SERVICES OUT TO A DISTANCE OF SEVERAL MILES. USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION THAT RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND SHOULD TAKE NECESSARY PRECAUTIONS TO AVOID POTENTIAL COMMUNICATION INTERFERENCE PROBLEMS.

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INTRODUCTION - NAV-402AP-3 TEST SET

This manual contains NAV-402AP-3 operating instructions for Marker, G/S, VOR, LOC, COMM and Auto Pilot systems. It is strongly recommended that personnel be thoroughly familiar with the contents of this manual before attempting to operate this equipment.

Refer all servicing of unit to qualified technical personnel.

ORGANIZATION

This manual is divided into the following Chapters and Sections:

CHAPTER 1 - OPERATION

Section 1 - DESCRIPTION (description of the NAV-402AP-3

Section 2 - OPERATION (installation; controls, connectors and indicators; and general operating procedures)

Section 3 - SPECIFICATIONS

Section 4 - SHIPPING

Section 5 - STORAGE

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SECTION 1 - DESCRIPTION

1. GENERAL DESCRIPTION AND CAPABILITIES

1.1 DESCRIPTION

The NAV-402AP-3 is a Bench and Ramp Test Set designed to meet the electronic functional test requirements of Category I and Category II ILS Systems, Communication (COMM), Navigation (NAV) and Marker (MKR) Systems.

The NAV-402AP-3 contains features to allow testing of sophisticated autopilot systems. These features include: automatic LOC DDM, automatic sweep, two fixed VOR frequencies; and two fixed, paired LOC and G/S frequencies.

1.2 FUNCTIONAL CAPABILITIES

The NAV-402AP-3 has the following features and capabilities:

- Signal Generator with a variable attenuator which can be connected to the equipment under test by a radiated signal from a self-contained antenna or by a coaxial cable. The signal generator can be operated under either fixed frequency control or in variable frequency mode in each band.
- The generator can be modulated internally by a 1020 Hz Ident Tone, Marker, VHF Omnidirectional Range (VOR), Localizer (LOC) or Glide Slope (G/S) Tones.
- A six-digit counter which indicates the RF of the signal generator on any band, the frequency of a COM Transmitter under test, any external signal input from 1 MHz to at least 300 MHz, or the VOR Bearing selected by the Bearing Select Switches.
- A built-in RF power meter measures COM Transmitter power, from 0-10W or 0-100W, either peak or average power by selecting a switch position located on the Front Panel. A COM Transmitter demodulation output permits viewing or listening to COM modulation.
- A built-in modulation meter measures Signal Generator Percent of Modulation on any frequency band from 0-30% or 0-100%. Front Panel controls permit quick setting of modulation percentages.

  90° bearing check monitor allows quick verification of basic VOR bearing from the VOR demod signal. NICAD battery and built-in charging system permit completely portable operation for up to 2 hours continuous duty. Any time the Test Set is plugged to an ac line, the battery is being charged. In battery operation, an automatic timer turns the Test Set off after 6 to 10 minutes. The Test Set can be recycled by pressing the PWR/BAT Switch to the BAT position.

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SECTION 2 - OPERATION

1. INSTALLATION

1.1 GENERAL

The Test Set is powered by an internal battery. The Test Set contains a battery charging circuit which enables the operator to recharge the battery when connected to ac power.

NOTE: The Test Set can operate continuously on ac power for servicing and/or bench tests.

Refer to 1-2-2, Figure 2 for location of controls, connectors or indicators.

1.2 BATTERY OPERATION

The internal battery (NICAD) is equipped to power the Test Set for two hours of continuous use, after which time, the Test Set battery needs recharging.

The 0 to 30% scale displays battery voltage. Normal battery charged condition is indicated as 15 V or greater. Less than 12.5 V indicates a discharged battery. An automatic low voltage cutoff circuit turns the Test Set OFF when the battery voltage drops under 12.5 V.

The Test Set contains an automatic time-out to conserve power. An automatic timer turns the Test Set OFF after 6 to10 minutes (only when using battery power). The Test Set can be recycled by pressing the PWR/BAT Switch to the BAT position.

1.3 BATTERY CHARGING

The battery charger operates whenever ac power is applied to the Test Set. The battery should be charged every three months (minimum).

NOTE: Overnight charging is recommended.

1.4 SAFETY PRECAUTIONS

The following safety precautions must be observed during installation and operation. Aeroflex assumes no liability for failure to comply with any safety precaution outlined in this manual.

1.4.1 Complying with Instructions

Installation/operating personnel should attempt to install or operate the Test Set only after reading and complying with instructions contained in this manual. All procedures contained in this manual must be performed in exact sequence and manner described.

1.4.2 Grounding Power Cord

WARNING: USE OF A THREE-PRONG TO TWO-PRONG ADAPTER PLUG CREATES A SHOCK HAZARD BETWEEN THE CHASSIS AND ELECTRICAL GROUND.

For ac operation, the power cord, equipped with standard three-prong plug, must be connected to a properly grounded three-prong receptacle.

It is the customer's responsibility to:

- Have a qualified electrician check receptacle(s) for proper grounding.
- Replace any standard two-prong receptacle(s) with properly grounded three-prong receptacle(s).

1.4.3 Operating Safety

Due to potential for electrical shock within test equipment, the Chassis Assembly must remain installed in the Case Assembly. Battery replacement must only be performed by qualified service technicians.

1.4.4 CAUTION and WARNING Labels

Exercise extreme care when performing operations preceded by a CAUTION or WARNING label. CAUTION labels appear where possibility of damage to equipment exists. WARNING labels denote conditions where bodily injury or death may result.

1.5 AC POWER REQUIREMENTS

The Test Set operates over a voltage range of 100 to 120 VAC at 60 Hz or 220 to 240 VAC at 50 Hz according to VOLTAGE SELECT Switch setting.

The specified fuse ratings are listed in 1-2-1, Table 1.

CAUTION: FOR CONTINUOUS PROTECTION AGAINST FIRE, REPLACE ONLY WITH FUSES OF THE SPECIFIED VOLTAGE AND CURRENT RATINGS.

INPUT VOLTAGE	F1 AND F2 FUSES
100 to 120 VAC	1.0 A, 250 V Fast Blo (Type F) (Aeroflex 5106-4501-000) (1.2in AGC Glass)
220 to 240 VAC	0.5 A, 250 V Fast Blo (Type F) (Aeroflex 5106-0000-016) (1.2in AGC Glass)

Specified Fuse Ratings
Table 1

1.6 FCC REQUIREMENTS

The Test Set is prohibited from use in VAR (variable) frequency modes during ramp use. Any test signals radiated from the antenna must be fixed frequencies. The Test Set is prohibited from externally modulating any band during ramp use. This includes microphones, audio generators, etc.

1.7 BATTERY RECHARGING

Refer to 1-2-1, Figure 1.

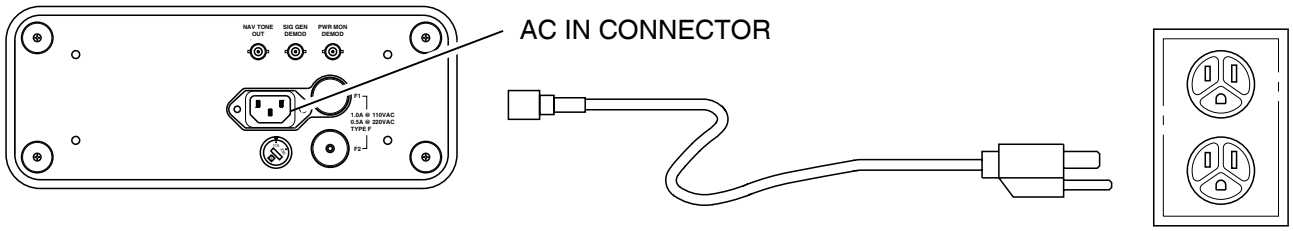
STEP PROCEDURE

1. Verify FUSES are correct for normal operating voltage. Refer to para 1-2-1.5.
2. Verify VOLTAGE SELECT Switch is set to the setting (115 or 230 VAC) that matches the input ac power.
3. Connect ac power cable between AC Power Connector and normal operating voltage power source, according to Test Set configuration. Refer to para 1-2-1.5.

   NOTE: The battery charger operates whenever ac power is applied to the Test Set.

4. Allow several hours for battery charge or until 0 to 30% scale displays battery voltage is 15 V or greater.

   NOTE: Overnight charging is recommended.



Battery Recharging
Figure 1

1.8 BENCH OPERATION

STEP	PROCEDURE

1. Verify FUSES are correct for normal operating voltage. Refer to para 1-2-1.5.
2. Verify VOLTAGE SELECT Switch is set to the setting (115 or 230 VAC) that matches the input ac power.
3. Connect ac power cable between AC Power Connector and normal operating voltage power source according to Test Set configuration. Refer to para 1-2-1.5.
4. Press PWR/BAT Switch to PWR position and verify POWER ON Indicator illuminates.
5. Connect UUT to Test Set.

1.9 EXTERNAL CLEANING

The following procedure contains routine instructions for cleaning the outside of the Test Set.

CAUTION: DISCONNECT POWER FROM TEST SET TO AVOID POSSIBLE DAMAGE TO ELECTRONIC CIRCUITS.

STEP	PROCEDURE

1. Clean front panel buttons and display face with soft lint-free cloth. If dirt is difficult to remove, dampen cloth with water and a mild liquid detergent.
2. Remove grease, fungus and ground-in dirt from surfaces with soft lint-free cloth dampened with isopropyl alcohol.
3. Remove dust and dirt from connectors with soft-bristled brush.
4. Cover unused connectors with suitable dust covers to prevent tarnishing of connector contacts.
5. Clean cables with soft lint-free cloth.
6. Paint exposed metal surface to avoid corrosion.

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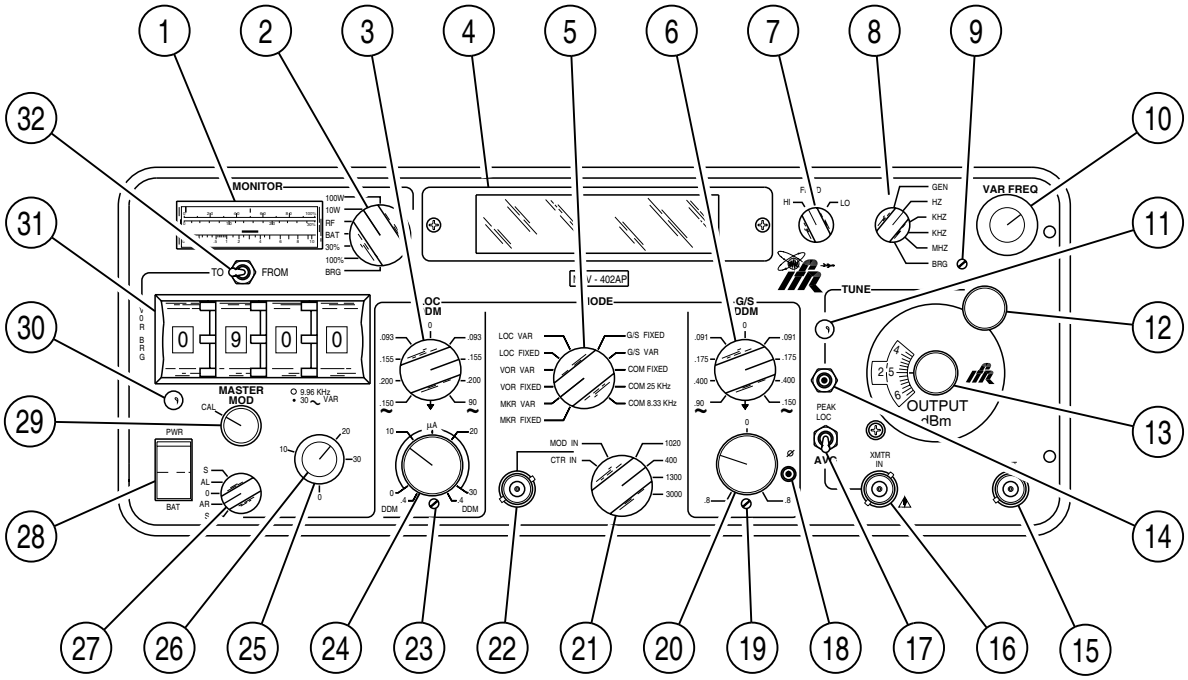
2. CONTROLS, CONNECTORS AND INDICATORS



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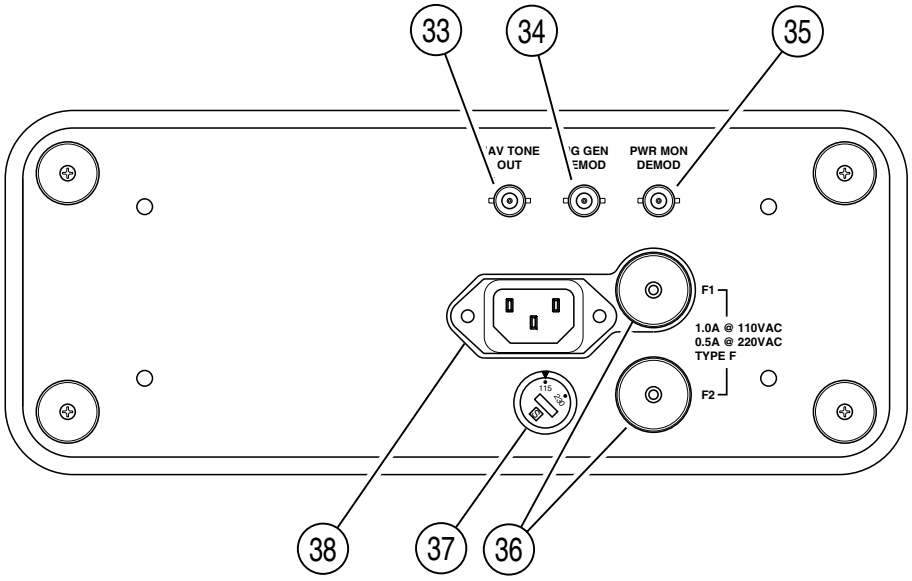

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NAV-402A-3 Front and Rear Panels
Figure 2

CONTROLS, CONNECTORS AND INDICATORS IN NUMERIC ORDER		CONTROLS, CONNECTORS AND INDICATORS IN ALPHABETICAL ORDER	
MONITOR Meter	1	30 Hz VAR LEVEL Control	26
MONITOR METER FUNCTION Switch	2	90/150 Hz VAR PHASE (ϕ) Switch	18
LOC DDM Control	3	9.96 kHz REF LEVEL Control	25
DIGITAL Display	4	AC IN Connector	38
FREQUENCY MODE Switch	5	AVG/PEAK LOC XMTR ON Switch	17
G/S DDM Control	6	COM XMTR IN Connector	16
CRYSTAL HI/LO Switch	7	COUNTER MODE Switch	8
COUNTER MODE Switch	8	CRYSTAL HI/LO Switch	7
METER BEARING CENTER Adjust	9	DIGITAL Display	4
VAR FREQ Controls	10	FINE TUNE Switch	14
TUNE Indicator	11	FREQUENCY MODE Switch	5
TUNE Control	12	FUSES	36
OUTPUT ATTENUATOR Control	13	G/S CENTER Adjust	19
FINE TUNE Switch	14	G/S DDM Control	6
RF OUT Connector	15	G/S VAR DDM Control	20
COM XMTR IN Connector	16	LOC CENTER Adjust	23
AVG/PEAK LOC XMTR ON Switch	17	LOC DDM Control	3
90/150 Hz VAR PHASE (ϕ) Switch	18	LOC DDM SWEEP Switch	27
G/S CENTER Adjust	19	LOC VAR DDM/DDM SWEEP AMPLITUDE Control	24
G/S VAR DDM Control	20	MASTER MOD LEVEL Control	29
TONE SELECT Switch	21	METER BEARING CENTER Adjust	9
MOD IN/EXT FREQ CTR IN Connector	22	MOD IN/EXT FREQ CTR IN Connector	22
LOC CENTER Adjust	23	MONITOR Meter	1
LOC VAR DDM/DDM SWEEP AMPLITUDE Control	24	MONITOR METER FUNCTION Switch	2
9.96 kHz REF LEVEL Control	25	NAV TONE OUT Connector	33
30 Hz VAR LEVEL Control	26	OUTPUT ATTENUATOR Control	13
LOC DDM SWEEP Switch	27	POWER ON Indicator	30
PWR/BAT Switch	28	PWR/BAT Switch	28
MASTER MOD LEVEL Control	29	PWR MON DEMOD Connector	35
POWER ON Indicator	30	RF OUT Connector	15
VOR BRG SELECT Switches	31	SIG GEN DEMOD Connector	34
VOR BRG TO/FROM Switch	32	TONE SELECT Switch	21
NAV TONE OUT Connector	33	TUNE Control	12
SIG GEN DEMOD Connector	34	TUNE Indicator	11
PWR MON DEMOD Connector	35	VAR FREQ Controls	10
FUSES	36	VOLTAGE SELECT Switch	37
VOLTAGE SELECT Switch	37	VOR BRG SELECT Switches	31
AC IN Connector	38	VOR BRG TO/FROM Switch	32

2.1 FRONT PANEL

Refer to 1-2-2, Figure 2.

ITEM DESCRIPTION

1. MONITOR Meter

   Provides, according to MONITOR METER FUNCTION Switch selection, analog indication of COM Transmitter RF power, Signal Generator RF level, Battery voltage, percent modulation of Signal Generator or VOR bearing errors at 90°.

2. MONITOR METER FUNCTION Switch

   Selects MONITOR Meter function:

   - ***10W*** selects 0 to 10 Watt scale (bottom scale) to measure COM Transmitter RF power.
   - ***100W*** selects 0 to 100 Watt scale (bottom scale X 10) to measure COM Transmitter RF power.
   - ***RF*** indicates best Signal Generator RF level by adjusting TUNE Control with FINE TUNE Switch pressed to set MONITOR Meter to center scale.
   - ***BAT*** selects 0 to 30% scale in volts to indicate internal Battery voltage. A ≥15 V reading indicates a fully charged Battery. A <12 V reading indicates a discharged Battery.
   - ***30%*** selects 0 to 30% scale to measure modulation level of Signal Generator.
   - ***100%*** selects 0 to 100% scale to measure modulation level of Signal Generator.
   - ***BRG*** checks VOR Generator at 90°. Center of the band indicates 0° bearing error. Left or right meter scale limit indicates bearing errors of ±0.5%.

ITEM DESCRIPTION

3. LOC DDM Control

   Selects amount of LOC pointer deviation of an ILS Indicator under test. Calibrations in DDM represent, standard deflection (***.093***), full scale (***.155***) and greater than full scale deflections (***.200***). Clockwise rotation provides upward deflection.

   The ***150 ~*** or ***90 ~*** position deletes the opposite tone (90 or 150 Hz) and sets the selected tone (150 or 90 Hz) to the same level as the on course value (20%) for a flag test.

   NOTE: Setting the G/S DDM Control to the same ***150 ~*** or ***90 ~*** position when using the Localizer function deletes the selected Localizer tone.

   Setting the LOC DDM Control to ***150 ~*** and the G/S DDM Control to ***90 ~*** or vice versa provides continuous wave operation.

   The ↓ position allows the LOC VAR DDM/DDM SWEEP AMPLITUDE Control to set continuously deviated deflection.

4. DIGITAL Display

   Provides digital readout of selected VOR bearing, internal Signal Generator frequency, external signal frequency or COM Transmitter frequency. The COUNTER MODE Switch determines displayed function.

ITEM DESCRIPTION

5. FREQUENCY MODE Switch

   Selects frequency band to be used: Marker (***MKR***), ***VOR***, Localizer (***LOC***), Glide Slope (***G/S***) or ***COMM***. Each band except ***COM*** has two positions; one with a fixed frequency (***FIXED***) and the other with a variable frequency (***VAR***). The ***COM*** band has three positions; one with a fixed frequency (***FIXED***) and two with variable frequencies (***COM 25kHz and COM 8.33kHz***).

6. G/S DDM Control

   Selects amount of G/S pointer deviation of an ILS Indicator under test. Calibrations in DDM represent standard deflection (***.091***), full scale (***.175***) and greater than full scale deflections (***.400***). Clockwise rotation provides upward deflection.

   The ***90 ~*** or ***150 ~*** position deletes the opposite tone (150 or 90 Hz) and sets the selected tone (90 or 150 Hz) to the same level as the on course value (40%) for a flag test.

   NOTE: Setting the LOC DDM Control to the same ***90 ~*** or ***150 ~*** position when using the Glide Slope function deletes the selected Glide Slope tone.

   Setting the G/S DDM Control to ***90 ~*** and the LOC DDM Control to ***150 ~*** or vice versa provides continuous wave (CW) operation.

   The ↓ position allows the G/S VAR DDM Control to set continuously deviated deflection.

ITEM DESCRIPTION

7. CRYSTAL HI/LO Switch

   Selects high (***HI***) or low (***LO***) fixed frequencies in ***G/S FIXED*** or ***VOR FIXED*** modes as selected by the FREQUENCY MODE Switch. The CRYSTAL HI/LO Switch also applies modulation to the appropriate Localizer Transmitter frequency when FREQUENCY MODE Switch is set to ***G/S FIXED***. The Test Set pairs Localizer Transmitter frequencies with G/S fixed frequencies when AVG/PEAK LOC XMTR ON Switch is set to ***PEAK LOC***.

8. COUNTER MODE Switch

   Selects signal source to be counted and shown on the DIGITAL Display:

   - ***GEN*** measures and display internal Signal Generator frequency.
   - ***HZ*** (1 Hz resolution), ***kHZ*** (10 Hz resolution), ***KHZ*** (100 Hz resolution) and ***MHZ*** (1 kHz resolution) measures and displays COM Transmitter frequency connected to COM XMTR IN Connector or external signal frequency connected to MOD IN/EXT FREQ CTR IN Connector.
   - ***BRG*** measures and displays digital bearing circuit output to verify bearing set by VOR BRG SELECT Switches. In the ***BRG*** position, the bearing monitor circuits also check VOR modulation for correct operation at 90°.

9. METER BEARING CENTER Adjust

   Used to center the MONITOR Meter when the MONITOR METER FUNCTION Switch is set to ***BRG*** and the COUNTER MODE Switch is set to any position <u>except</u> ***BRG***. The METER BEARING CENTER Adjust sets a reference level in the internal bearing check operation.

ITEM DESCRIPTION

10. VAR FREQ Controls

    Coarse and fine controls manually channel sweep the internal Signal Generator frequency when the FREQUENCY MODE Switch is in a ***VAR*** position. Clockwise rotation increases the frequency.

11. TUNE Indicator

    Indicates a tuned Signal Generator. The TUNE Indicator stops illuminating when the Signal Generator is within the fine tune range.

12. TUNE Control

    NOTE: For maximum accuracy, the TUNE Control should be adjusted prior to any receiver tests.

    Adjusts the Signal Generator for optimum tuning. The TUNE Control requires readjustment when:

    - Selecting a different frequency band with the FREQUENCY MODE Switch.
    - Adjusting VAR FREQ Controls to change frequency more than a few MHz in any one band.
    - Setting or changing the OUTPUT ATTENUATOR Control.

13. OUTPUT ATTENUATOR Control

    Adjusts the Signal Generator output level at the RF OUT Connector into a 50 Ω load. The attenuator dial is calibrated in -dBm (dB below 1 mW). The dial is accurate below -30 dBm. Another chart (also included with the Test Set) converts -dBm to soft μV.

    NOTE: Soft μV are μV measured with 50 Ω loading. Hard μV are μV measured through a 6 dB attenuator, into a 50 Ω load.

14. FINE TUNE SwitchThis switch fine tunes the Signal Generator output when the TUNE Indicator stops illuminating (signal within tune range). With the FINE TUNE Switch pressed, the TUNE Control tunes the signal for minimum deflection from 0 (zero) on the MONITOR Meter.

ITEM DESCRIPTION

15. RF OUT Connector

    Provides the attenuated Signal Generator output to UUT. The connected UUT should provide a 50 Ω termination to the RF OUT Connector.

    NOTE: The RF OUT Connector is diode protected against an accidentally keyed COM Transmitter.

16. COM XMTR IN Connector

    CAUTION: MAXIMUM INPUT SHOULD STAY WITHIN LIMITS DEFINED IN 1-3-1, TABLE 2, INPUT POWER VERSUS TIME LIMITS.

    Provides an input to the MONITOR Meter. Allows for power and frequency measurements when connected to a COM Transmitter using a 50 Ω cable.

    When the MONITOR METER FUNCTION Switch is set to ***10W*** or ***100W***, the MONITOR METER indicates COM Transmitter power, either peak (AVG/PEAK LOC XMTR ON Switch set to ***PEAK LOC***) or average (AVG/PEAK LOC XMTR ON Switch set to ***AVG***). The Test Set connects an internal 25 dB attenuator in series with the power monitor circuit.

    When the COUNTER MODE Switch is set to ***HZ***, ***KHZ***, ***KHZ*** or ***MHZ***, the DIGITAL Display indicates COM Transmitter frequency.

ITEM DESCRIPTION

17. AVG/PEAK LOC XMTR ON Switch

    Selects power meter function displayed on MONITOR Meter when MONITOR METER FUNCTION Switch is set to ***10W*** or ***100W***:

    - ***PEAK*** sets the MONITOR Meter to display peak power amplitude of a COM Transmitter with modulation applied. PEAK also provides Localizer Transmitter output simultaneously with the Glide Slope signal when the FREQUENCY MODE Switch is set to ***G/S FIXED*** (for checking Autopilots or Course Computers).
    - ***AVG*** sets the MONITOR Meter for displaying the average RF power of a COM Transmitter and disregards power changes due to proper modulation.

18. 90/150 Hz VAR PHASE (ϕ) Switch

    Varies the phase (ϕ) of the 150 Hz tone relative to the 90 Hz tone. Normally, the 90 and 150 Hz tones, used in Glide Slope and Localizer simulations, are locked in phase together. Adjusting the VOR BRG SELECT Switches while pressing the 90/150 Hz VAR PHASE (ϕ) Switch, changes phase relationship. If the VOR BRG SELECT Switches are set to ***000.0***, pressing the 90/150 Hz VAR PHASE (ϕ) Switch produces no change in phase. Each 1° step selected on the VOR BRG SELECT Switches shifts the 150 Hz tone 5° relative to the 90 Hz tone. The 90 Hz tone always remains constant in phase relative to the ***000.0*** set on the VOR BRG SELECT Switches.

    Setting the VOR BRG SELECT Switches to ***024.0*** (24° VOR bearing) with the 90/150 Hz VAR PHASE (ϕ) Switch pressed puts the 90 and 150 Hz tones in original phase relationship. Setting the VOR BRG SELECT Switches to ***012.0*** (12° VOR bearing) with the 90/150 Hz VAR PHASE (ϕ) Switch pressed, places the amplitude summation of the 90 and 150 Hz tones at maximum magnitude.

ITEM DESCRIPTION

19. G/S CENTER Adjust

    Varies the amplitude of the 90 Hz tone and controls exact course centering for Glide Slope modulation.

20. G/S VAR DDM Control

    Continuously varies G/S pointer deflection from counterclockwise (ccw) ***0.8 DDM*** (down) through ***0 DDM*** to clockwise (cw) ***0.8 DDM*** (up). Setting the G/S DDM Control to ↓ activates the G/S VAR DDM Control.

21. TONE SELECT Switch

    Selects modulation input to the internal Signal Generator or input to the internal digital Counter:

    - ***CTR IN*** connects the MOD IN/EXT FREQ CTR IN Connector input to the Counter, active with COUNTER MODE Switch set to ***HZ***, ***KHZ***, ***KHZ*** or ***MHZ***.
    - ***MOD IN*** applies the MOD IN/EXT FREQ CTR IN Connector modulation to the Signal Generator.
    - ***1020*** applies 1020 Hz modulation to the frequency band (except G/S) set by FREQUENCY MODE Switch.
    - ***400*** applies 400 Hz modulation to the frequency band (except G/S) set by FREQUENCY MODE Switch.
    - ***1300*** applies 1300 Hz modulation to the frequency band (except G/S) set by FREQUENCY MODE Switch.
    - ***3000*** applies 3000 Hz modulation to the frequency band (except G/S) set by FREQUENCY MODE Switch.

22. MOD IN/EXT FREQ CTR IN Connector

    Provides an input for external modulation to the internal Signal Generator or a 1 to 300 MHz signal to the internal digital Counter as selected by the TONE SELECT Switch.

ITEM DESCRIPTION

23. LOC CENTER Adjust

    Varies the amplitude of the 90 Hz tone and controls exact course centering for Localizer modulation.

24. LOC VAR DDM/DDM SWEEP AMPLITUDE Control

    Controls variable Localizer DDM/DDM sweep amplitude when the LOC DDM Control is set to ↓ and according to LOC DDM SWEEP Switch setting:

    - LOC DDM SWEEP Switch set to ***O.***

      Continuously varies LOC pointer deflection from ccw ***0.4 DDM*** (left) through ***0 DDM*** to cw ***0.4 DDM*** (right).

    - LOC DDM SWEEP Switch set to ***AL***, ***S*** or ***AR.***

      Sets the maximum DDM deflection/sweep amplitude from 0 to 30 μA (±0.0155 DDM) for an automatic LOC DDM sweep.

25. 9.96 kHz REF LEVEL Control

    Adjusts modulation percentage of the 9.96 kHz VAR tone (part of VOR composite signal) from 0 to 30%. The 9.96 kHz VAR LEVEL Control (outside larger knob) reaches 30% when turned past ***30*** to the stop.

26. 30 Hz VAR LEVEL Control

    Adjusts modulation percentage of the 30 Hz VAR tone (part of VOR composite signal) from 0 to 30%. The 30 Hz VAR LEVEL Control (inside smaller knob) reaches 30% when turned past ***30*** to the stop.

27. LOC DDM SWEEP Switch

    Sets the Localizer sweep mode:

    - ***O*** allows manual sweep or variable DDM adjusted by LOC VAR DDM/DDM SWEEP AMPLITUDE Control.
    - ***AR*** (arm right) or ***AL*** (arm left) initializes internal sweep circuit to 0 DDM and determines initial sweep direction prior to selecting sweep mode (***S***).

ITEM DESCRIPTION

27. LOC DDM SWEEP Switch (cont)

    - ***S*** initiates automatic LOC DDM sweep beginning at 0 DDM and deflecting to the direction according to the prior arming setting (***AR*** or ***AL***). The sweep continues to the maximum pointer deflection determined by the LOC VAR DDM/DDM SWEEP AMPLITUDE Control setting. The sweep reverses and continues to the maximum pointer deflection in the other direction. The sweep is symmetrical relative to 0 DDM.

28. PWR/BAT Switch

    Two position switch controls power to the Test Set:

    - ***PWR*** connects Test Set to ac line power connected to AC IN Connector.
    - ***BAT*** connects or disconnects Test Set from internal Battery. Connecting the Test Set to the Battery activates an internal battery timer. Test Set operation disconnects from the internal Battery after reaching the internal battery timer limit (≈6 to 10 minutes) or by pressing the PWR/BAT Switch to ***BAT*** to disconnect.

29. MASTER MOD LEVEL Control

    Controls modulation level of all modulating tones:

    - ***CAL*** (detent) position (fully ccw) fixes modulation levels of each type of signal to normal values; 20% for LOC, 30% for VOR and COMM, 40% for G/S and 95% for MKR.
    - Other than ***CAL***, adjusts modulation levels of each type of signal from 3% to 35% for LOC, 55% for VOR and COMM, 75% for G/S and 96% for G/S.

2.2 REAR PANEL

Refer to 1-2-2, Figure 2.

ITEM	DESCRIPTION
30.	POWER ON Indicator Illuminates when applying ac or battery power to the Test Set.
31.	VOR BRG SELECT Switches Four thumbwheel switches select the VOR bearing, in degrees, simulated by the Test Set. Valid range is ***0***° to ***360.0***°.
32.	VOR BRG TO/FROM Switch Changes VOR bearing selected by VOR BRG SELECT Switches to reciprocal bearing for flag tests, etc.
33.	NAV TONE OUT Connector Provides audio output to test VOR bearing circuits or deviation circuits of Localizer and Glide Slope Navigational Receivers. The MASTER MOD LEVEL Control varies the output level ≈0 to 7 Vp-p into 1000 Ω. The NAV TONE OUT Connector also provides access to the audio modulation of the Marker and COM signals by connecting internally to the Test Set Modulator.
34.	SIG GEN DEMOD Connector Provides demodulated output of the internal Signal Generator. The output, used for monitoring Test Set capability, can feed VOR and ILS Converters. If the available output voltage is adequate and the ≈+4.25 Vdc component is acceptable, the output can drive a Converter.
35.	PWR MON DEMOD Connector Provides access to the demodulated output of a COM Transmitter connected to the COM XMTR IN Connector. The output can be used to display modulation on an oscilloscope or listen to modulation through an external amplifier.
36.	FUSES Fuses input power to the Test Set. Refer to Table 1-2-1, Table 1 for correct fuse size and type.
37.	VOLTAGE SELECT Switch Selects 115 or 230 VAC to match input ac power.
38.	AC IN Connector Provides input for external ac power. Refer to para 1-2-1.5 for Power Requirements.

3. GENERAL OPERATING PROCEDURES

3.1 GENERAL

This section contains operating instructions for the NAV-402AP-3. The operating instructions contain general procedures, identifying the controls, connectors, indicators used for the individual test functions. For specific Unit Under Test (UUT) Procedures, refer to the appropriate UUT Manual.

CAUTION: WHEN OPERATING THE TEST SET IN A VERTICAL POSITION, REMOVE THE LID TO PREVENT THE TEST SET FROM TIPPING OVER.

Refer to 1-2-2, Figure 2 for location of controls, connectors and indicators.

3.2 SIGNALS SIMULATED

The NAV-402AP-3 is a bench and ramp test instrument for MARKER, VOR, ILS and COM equipment.

The NAV-402AP-3 simulates MARKER signals with Inner (3000 Hz), Middle (1300 Hz) and Outer (400 Hz) tones.

VOR Ground Station signals are simulated by an RF signal modulated by a 30 Hz reference signal, a variable 30 Hz signal and a 9960 Hz signal.

Localizer (LOC) signals are simulated by modulating RF with 90 and 150 Hz tones.

Glide Slope (G/S) signals are simulated by modulating RF with 90 and 150 Hz tones.

COM signals are simulated by modulating RF with the 400, 1300 or 3000 Hz MARKER tones or the 1020 Hz IDENT tone. IDENT can also be applied to MARKER, VOR or Localizer signals.

3.3 OPERATION CAUTIONS

The NAV-402AP-3 must be used in the following frequency fixed modes during ramp use:

- COM
- G/S
- LOC
- VOR

3.4 RAMP OPERATION

With the exception of Marker Beacon, most NAV COM systems of a typical avionics package can be checked when the Test Set is placed in a vertical position in the cockpit. The antenna is extended vertically 2-3 ft. With the antenna on the RF Output Connector, the VOR, LOC and G/S modes of NAV COM Receivers can be checked and indicators operated through the limits. The COM Receiver can also be operated, modulating the Test Set with either the 400, 1300 or 300 Hz tones or the 1020 Hz IDENT tone.

On some installations, the Marker Antenna is located far aft on the fuselage. When this occurs, and receiver sensitivity is low (-35 to -45 dBm), the Test Set situated in the cockpit radiates RF insufficient to operate the Receiver. Moving the Test Set outside the aircraft normally provides more than enough signal strength to completely check Marker audio and lights.

To check COM Transmitter frequencies from the cockpit, connect the COM Transmitter output to the COM Transmitter Input Connector and select MHz on the COUNTER MODE Switch. The Test Set reads out the COM Transmitter frequency when the COM Transmitter is keyed.

3.5 BENCH OPERATION

Bench testing dictates the use of direct coaxial cable connections between the Test Set and UUT. The Attenuator Dial readout is the RF level in dBm present at the RF OUT Connector into 50 Ω. To conduct accurate sensitivity measurements, the loss in dBm of the connecting coaxial cables must be known.

CAUTION: MOST COM RECEIVER ANTENNA CONNECTORS ARE ALSO USED FOR THE COM TRANSMITTER CONNECTOR. THE TRANSMITTER SHOULD BE KEYED ONLY WHEN THE COM ANTENNA CONNECTOR IS DISCONNECTED FROM THE TEST SET RF OUT CONNECTOR. DAMAGE TO THE ATTENUATOR AND SIGNAL GENERATOR SYSTEM MAY RESULT.

3.6 COUNTER OPERATION

With the TONE SELECT Switch in the CTR IN position, the Test Set Counter may be utilized as a general utility Counter. Frequencies from 1 to 300 MHz can be measured. The Counter Mode Switch can be used in any of the four time base positions: Hz, kHz, KHz or MHz.

3.7 BATTERY PARAMETERS

The battery permits completely portable ramp operation for up to two hours.

In battery operation, an automatic timer turns the Test Set OFF after 6 to 10 minutes. The Test Set can be recycled by pressing the PWR/BAT Switch to the BAT position.

With the MONITOR METER FUNCTION switch in the BAT position, the MONITOR meter 0 to 30% scale displays battery voltage. Normal battery charged condition is indicated as ≥15 V or greater. Battery voltage <12.5 V indicates a discharged battery. An automatic low voltage cutoff circuit turns the Test Set OFF when the battery voltage drops under 12.5 V.

NOTE: If the Test Set is used only for bench operation, the battery can lose storage ability. The Test Set should be periodically operated on battery power to allow the battery to partially discharge.

3.8 OPERATE LOC AND G/S SIMULTANEOUSLY

To operate the LOC and G/S outputs simultaneously:

- Adjust all controls for normal G/S operation (G/S FIXED mode, only). The Output Attenuator varies the RF level of the G/S signal, and G/S DDM controls vary the DDM of the G/S signal.
- Select LOC with the AVG/PEAK LOC XMTR ON Switch to activate a separate Localizer generator in the Test Set. This generator output is combined with the G/S output at the RF Output Connector at the fixed level of -18 dBm (approx.). LOC DDM Controls vary the DDM of the Localizer signal.

3.9 MARKER OPERATION (TYPICAL CONTROL SETTINGS)

STEP	PROCEDURE
1.	MONITOR METER FUNCTION Switch ***RF*** to verify proper leveling of internal Signal Generator on the MONITOR Meter. ***100%*** to verify 95% modulation of Signal Generator on the MONITOR Meter.
2.	FREQUENCY MODE Switch ***MKR FIXED*** is mandatory in ramp operation and is used on bench for standard Marker center frequency. ***MKR VAR*** Set VAR FREQ Controls to select the desired channel in 25 kHz steps.
3.	COUNTER MODE Switch ***GEN*** to read out the Signal Generator frequency on the DIGITAL Display when operating in fixed (FIXED) or variable (VAR) modes.
4.	TUNE Control Adjust until TUNE Indicator stops illuminating, indicating Signal Generator is in the fine tune range.
5.	FINE TUNE Switch Press and adjust TUNE Control until MONITOR Meter indicates least deflection from left.
6.	OUTPUT ATTENUATOR Control Use as needed to establish Receiver sensitivities.
7.	RF OUT Connector Connect to Receiver Antenna Connector, or attach Antenna in ramp operation.
8.	TONE SELECT Switch Select desired tone: ***1020*** (Ident tone), ***400***, ***1300*** or ***3000*** Hz.
9.	MASTER MOD LEVEL Control Set to ***CAL*** for 95% or variable from 3% to 96%.
10.	PWR/BAT Switch ***PWR*** to use external ac line power through the AC IN Connector. ***BAT*** to initiate operation using internal battery.

3.10 VOR OPERATION (TYPICAL CONTROL SETTINGS)

STEP	PROCEDURE

1. MONITOR METER FUNCTION Switch

   RF to verify proper leveling of internal Signal Generator on the MONITOR Meter.

   30% or ***100%*** to verify or set 30% modulation of each VOR modulating tone.

   BRG to verify operation of bearing signal at 90° (internally).

2. COUNTER MODE Switch

   GEN to read out the Signal Generator frequency on the DIGITAL Display when operating in fixed (FIXED) or variable (VAR) modes.

3. FREQUENCY MODE Switch

   VOR FIXED is mandatory in ramp operation and is used on bench for a fixed channel center frequency.

   VOR VAR to check all channel bench operation. Set VAR FREQ Controls to select the desired channel in 25 kHz steps.

4. TUNE Control

   Adjust until TUNE Indicator stops illuminating, indicating Signal Generator is in the fine tune range.

5. FINE TUNE Switch

   Press and adjust TUNE Control until MONITOR Meter indicates least deflection from left.

6. OUTPUT ATTENUATOR Control

   Use as needed to establish Receiver sensitivities.

7. RF OUT Connector

   Connect to Receiver Antenna Connector, or attach Antenna in ramp operation.

8. TONE SELECT Switch

   Select desired tone: ***1020*** (Ident tone), ***400***, ***1300*** or ***3000*** Hz.

STEP	PROCEDURE

9. 30 Hz VAR LEVEL Control

   Vary the 30 Hz modulation level from 0% to 30%.

10. 9.96 kHz REF LEVEL Control

    Vary the 9.96 kHz modulation level from 0% to 30%.

11. MASTER MOD LEVEL Control

    Set to ***CAL*** for 30% for each VOR tone or variable from 3% to 55% for each VOR tone.

12. PWR/BAT Switch

    PWR to use external ac line power through the AC IN Connector.

    BAT to initiate operation using internal Battery.

13. VOR BRG SELECT Switches

    Set to desired bearing for radial testing and alignment.

14. VOR BRG TO/FROM Switch

    Set to obtain reciprocals of selected bearings for Indicator flag tests.

15. CRYSTAL HI/LO Switch (FREQUENCY MODE Switch set to ***VOR FIXED***)

    HI for 112.8 MHz RF output.

    LO for 108 MHz RF output.

3.11 LOCALIZER OPERATION (TYPICAL CONTROL SETTINGS)

STEP	PROCEDURE
1.	MONITOR METER FUNCTION Switch ***RF*** to verify proper leveling of internal Signal Generator on the MONITOR Meter. ***30%*** to verify or set 20% modulation of each modulating tone and set course centering on the MONITOR Meter.
2.	COUNTER MODE Switch ***GEN*** to read out the Signal Generator frequency on the DIGITAL Display when operating in fixed (FIXED) or variable (VAR) modes.
3.	FREQUENCY MODE Switch ***LOC FIXED*** is mandatory in ramp operation and is used on bench for a fixed channel center frequency. ***LOC VAR*** to check all channel bench operation. Set VAR FREQ Controls to select the desired channel in 25 kHz steps.
4.	TUNE Control Adjust until TUNE Indicator stops illuminating, indicating Signal Generator is in the fine tune range.
5.	FINE TUNE switch Press and adjust TUNE Control until MONITOR Meter indicates least deflection from left.
6.	OUTPUT ATTENUATOR Control Use as needed to establish Receiver sensitivities.
7.	RF OUT Connector Connect to Receiver Antenna Connector, or attach Antenna in ramp operation.
8.	TONE SELECT Switch Select audio tone: ***1020*** (Ident tone), ***400***, ***1300*** or ***3000*** Hz as desired.
9.	LOC DDM Control Use steps for precise amounts of deflection and flag tests.
10.	LOC DDM/DDM SWEEP AMPLITUDE Control Use to check Auto-pilot Servos, meter stickiness, etc. or to set DDM sweep amplitude.
11.	LOC DDM SWEEP Switch Use to select initial direction of DDM sweep.
12.	MASTER MOD LEVEL Control Set to ***CAL*** for 20% each course tone and 30% audio tone or variable from 3% to 35% each course tone and 3% to 55% audio tone.
13.	PWR/BAT Switch ***PWR*** to use external ac line power through the AC IN Connector. ***BAT*** to initiate operation using internal Battery power.

3.12 GLIDE SLOPE OPERATION (TYPICAL CONTROL SETTINGS)

STEP	PROCEDURE
1.	MONITOR METER FUNCTION Switch ***RF*** to verify proper leveling of internal Signal Generator on the MONITOR Meter. ***100%*** to verify or set 40% modulation of each modulating tone and set course centering on the MONITOR Meter.
2.	COUNTER MODE Switch ***GEN*** to read out the Signal Generator frequency on the DIGITAL Display when operating in fixed (FIXED) or variable (VAR) modes.
3.	FREQUENCY MODE Switch ***G/S FIXED*** is mandatory in ramp operation and is used on bench for a fixed channel center frequency. ***G/S VAR*** to check all channel bench operation. Set VAR FREQ Controls to select the desired channel in 50 kHz steps.
4.	CRYSTAL HI/LO Switch (FREQUENCY MODE Switch set to G/S FIXED **HI** for 334.7 MHz RF output **LO** for 329.6 MHz RF output.
5	TUNE Control Adjust until TUNE Indicator stops illuminating, indicating Signal Generator is in the fine tune range.
6.	FINE TUNE switch Press and adjust TUNE Control until MONITOR Meter indicates least deflection from left.
7.	OUTPUT ATTENUATOR Control Use as needed to establish Receiver sensitivities.
8.	RF OUT Connector Connect to Receiver Antenna Connector, or attach Antenna in ramp operation.

STEP	PROCEDURE
9.	G/S DDM Control Use steps for precise amounts of deflection and flag tests.
10.	G/S VAR DDM Control Use to check Auto-pilot Servos, meter stickiness, etc.
11.	MASTER MOD LEVEL Control Set to ***CAL*** for 40% each course tone or variable from 3% to 75%.
12.	PWR/BAT Switch ***PWR*** to use external ac line power through the AC IN Connector. ***BAT*** to initiate operation using internal Battery power.
13.	AVG/PEAK LOC XMTR Switch (FREQUENCY MODE Switch set to ***G/S FIXED***) ***PEAK LOC*** for simultaneous G/S and LOC output.

3.13 COMMUNICATION OPERATION (RECEIVER TESTS) (TYPICAL CONTROL SETTINGS)

STEP	PROCEDURE
1.	MONITOR METER FUNCTION Switch ***RF*** to verify proper leveling of internal Signal Generator on the MONITOR Meter. ***30%*** or ***100%*** to verify or set 30% sine-wave modulation tone on the MONITOR Meter.
2.	COUNTER MODE Switch ***GEN*** to read out the Signal Generator frequency on the DIGITAL Display when operating in fixed (FIXED) or variable (VAR) modes.
3.	FREQUENCY MODE Switch ***COM FIXED*** is mandatory in ramp operation and is used on bench for a stable channel center frequency. ***COM 25 KHz*** to check COM Receiver channels. Set VAR FREQ Controls as desired from 118.000 to 156.000 MHz, in 25 KHz steps. ***COM 8.33 KHz*** to check COM Receiver channels. Set VAR FREQ Controls as desired from 118.000 to 156.000 MHz, in 8.33 kHz steps. (1-2-3, Table 1)
4.	VAR FREQ Controls (FREQUENCY MODE Switches set to ***COM 25 KHz*** or ***COM 8.33 KHz***) Use as needed to change COM frequency in 25 kHz steps or 8.33 kHz steps as determined by the frequency mode switch.
5.	TUNE Control Adjust until TUNE Indicator stops illuminating, indicating Signal Generator is in the fine tune range.
6.	FINE TUNE Switch Press and adjust TUNE Control until MONITOR Meter indicates least deflection from left.
7.	OUTPUT ATTENUATOR Control Use as needed to establish Receiver sensitivities.
8.	RF OUT Connector Connect to Receiver Antenna Connector, or attach Antenna in ramp operation.
9.	TONE SELECT Switch Select audio tone: ***1020***, ***400***, ***1300*** or ***3000*** Hz as desired; or ***MOD IN*** to apply external modulation through MOD IN/EXT FREQ CTR IN Connector (bench testing only).
10.	MOD IN/EXT FREQ CTR IN Connector (TONE SELECT Switch set to ***MOD IN***) Use to apply external modulation to Signal Generator.
11.	MASTER MOD LEVEL Control Set to ***CAL*** for 30% each tone or variable from 3% to 55%.
12.	PWR/BAT Switch ***PWR*** to use external ac line power through the AC IN Connector. ***BAT*** to initiate operation using internal Battery power.

STEP PROCEDURE

12. PWR/BAT Switch (cont)

NOTE: Sequence repeats every 100 kHz, from 118.000 MHz to 156.000 MHz.

LAST 2 DIGITS OF DIGITAL DISPLAY	NOMINAL OUTPUT FREQUENCY
00	xxx.x0000 MHz
08 OR 09	xxx.x0833 MHz
16 OR 17	xxx.x1666 MHz
25	xxx.x2500 MHz
33 or 34	xxx.x3333 MHz
41 or 42	xxx.x4166 MHz
50	xxx.x5000 MHz
58 or 59	xxx.x5833 MHz
66 or 67	xxx.x6666 MHz
75	xxx.x7500 MHz
83 or 84	xxx.x8333 MHz
91 or 92	xxx.x9166 MHz

Displayed Frequency vs Actual Nominal Output Frequency in COM 8.33 kHz Mode
Table 1

3.14 COMMUNICATION OPERATION (TRANSMITTER TESTS) (TYPICAL CONTROL SETTINGS)

STEP PROCEDURE

1. MONITOR METER FUNCTION Switch

   10W or ***100W*** to measure COM Transmitter power on the MONITOR Meter.

2. COUNTER MODE Switch

   HZ or ***KHZ*** to measure COM Transmitter frequency as shown on the DIGITAL Display.

   KHZ or ***MHZ*** to measure COM Transmitter frequency (in HF or VHF bands) as shown on the DIGITAL Display.

3. COM XMTR IN Connector

   Connect to COM Transmitter output.

4. AVG/PEAK LOC XMTR Switch

   PEAK LOC for indicating increase in power during modulation as shown on the MONITOR Meter.

   AVG for indicating only average power on the MONITOR Meter, disregarding modulation.

5. TONE SELECT Switch

   CTR IN to measure COM Transmitter frequencies over the air through the MOD IN/EXT FREQ CTR IN Connector.

6. MOD IN/EXT FREQ CTR IN Connector (TONE SELECT Switch set to ***CTR IN***)

   Connect Whip Antenna for COM frequency measurements in portable operation.

7. PWR/BAT Switch

   PWR to use external ac line power through the AC IN Connector.

   BAT to initiate operation using internal Battery power.

DECIBELS	VOLTS	WATTS
+40 dBw	709 V	10.00 kW
+39 dBw	633 V	7.94 kW
+38 dBw	563 V	6.32 kW
+37 dBw	501 V	5.00 kW
+36 dBw	447 V	3.98 kW
+35 dBw	399 V	3.16 kW
+34 dBw	355 V	2.51 kW
+33 dBw	317 V	2.00 kW
+32 dBw	282 V	1.59 kW
+31 dBw	252 V	1.26 kW
+30 dBw	224 V	1.00 kW
+29 dBw	200 V	794 W
+28 dBw	178 V	632 W
+27 dBw	159 V	500 W
+26 dBw	141 V	398 W
+25 dBw	126 V	316 W
+24 dBw	112 V	251 W
+23 dBw	100 V	200 W
+22 dBw	89.1 V	159 W
+21 dBw	79.5 V	126 W
+20 dBw	70.9 V	100 W
+19 dBw	63.3 V	79.4 W
+18 dBw	56.3 V	63.2 W
+17 dBw	50.1 V	50.0 W
+16 dBw	44.7 V	39.8 W
+15 dBw	39.9 V	31.6 W
+14 dBw	35.5 V	25.1 W
+13 dBw	31.7 V	20.0 W
+12 dBw	28.2 V	15.9 W
+11 dBw	25.2 V	12.6 W
+10 dBw	22.4 V	10.0 W
+9 dBw	20.0 V	7.94 W
+8 dBw	17.8 V	6.32 W
+7 dBw	15.9 V	5.00 W
+6 dBw	14.1 V	3.98 W

DECIBELS	VOLTS	WATTS
+5 dBw	12.6 V	3.16 W
+4 dBw	11.2 V	2.51 W
+3 dBw	10.0 V	2.00 W
+2 dBw	8.91 V	1.59 W
+1 dBw	7.95 V	1.26 W
+30 dBm	7.09 V	1.00 W
+29 dBm	6.33 V	794 mW
+28 dBm	5.63 V	632 mW
+27 dBm	5.01 V	500 mW
+26 dBm	4.47 V	398 mW
+25 dBm	3.99 V	316 mW
+24 dBm	3.55 V	251 mW
+23 dBm	3.17 V	200 mW
+22 dBm	2.82 V	159 mW
+21 dBm	2.52 V	126 mW
+20 dBm	2.24 V	100 mW
+19 dBm	2.00 V	79.4 mW
+18 dBm	1.78 V	63.2 mW
+17 dBm	1.59 V	50.0 mW
+16 dBm	1.41 V	39.8 mW
+15 dBm	1.26 V	31.6 mW
+14 dBm	1.12 V	25.1 mW
+13 dBm	1.00 V	20.0 mW
+12 dBm	891 mV	15.9 mW
+11 dBm	795 mV	12.6 mW
+10 dBm	709 mV	10.0 mW
+9 dBm	633 mV	7.94 mW
+8 dBm	563 mV	6.32 mW
+7 dBm	501 mV	5.00 mW
+6 dBm	447 mV	3.98 mW
+5 dBm	399 mV	3.16 mW
+4 dBm	355 mV	2.51 mW
+3 dBm	317 mV	2.00 mW
+2 dBm	282 mV	1.59 mW
+1 dBm	252 mV	1.26 mW

Correspondence Chart for Decibels, Volts and Watts
Table 2

DECIBELS	VOLTS	WATTS
+0 dBm	224 mV	1.00 mW
-1 dBm	200 mV	794 µW
-2 dBm	178 mV	632 µW
-3 dBm	159 mV	500 µW
-4 dBm	141 mV	398 µW
-5 dBm	126 mV	316 µW
-6 dBm	112 mV	251 µW
-7 dBm	100 mV	200 µW
-8 dBm	89 mV	159 µW
-9 dBm	79 mV	126 µW
-10 dBm	70.9 mV	100 µW
-11 dBm	63.3 mV	79.4 µW
-12 dBm	56.3 mV	63.2 µW
-13 dBm	50.1 mV	50.0 µW
-14 dBm	44.7 mV	39.8 µW
-15 dBm	39.9 mV	31.6 µW
-16 dBm	35.5 mV	25.1 µW
-17 dBm	31.7 mV	20.0 µW
-18 dBm	28.2 mV	15.9 µW
-19 dBm	25.2 mV	12.6 µW
-20 dBm	22.4 mV	10.0 µW
-21 dBm	20.0 mV	7.94 µW
-22 dBm	17.8 mV	6.32 µW
-23 dBm	15.9 mV	5.00 µW
-24 dBm	14.1 mV	3.98 µW
-25 dBm	12.6 mV	3.16 µW
-26 dBm	11.2 mV	2.51 µW
-27 dBm	10.0 mV	2.00 µW
-28 dBm	8.9 mV	1.59 µW
-29 dBm	7.95 mV	1.26 µW
-30 dBm	7.09 mV	1.00 µW
-31 dBm	6.33 mV	794 nW
-32 dBm	5.63 mV	632 nW
-33 dBm	5.01 mV	500 nW
-34 dBm	4.47 mV	398 nW

DECIBELS	VOLTS	WATTS
-35 dBm	3.99 mV	316 nW
-36 dBm	3.55 mV	251 nW
-37 dBm	3.17 mV	200 nW
-38 dBm	2.82 mV	159 nW
-39 dBm	2.52 mV	126 nW
-40 dBm	2.24 mV	100 nW
-41 dBm	2.00 mV	79.4 nW
-42 dBm	1.78 mV	63.2 nW
-43 dBm	1.59 mV	50.0 nW
-44 dBm	1.41 mV	39.8 nW
-45 dBm	1.26 mV	31.6 nW
-46 dBm	1.12 mV	25.1 nW
-47 dBm	1.00 mV	20.0 nW
-48 dBm	891 µV	15.9 nW
-49 dBm	795 µV	12.6 nW
-50 dBm	709 µV	10.0 nW
-51 dBm	633 µV	7.94 nW
-52 dBm	563 µV	6.32 nW
-53 dBm	501 µV	5.00 nW
-54 dBm	447 µV	3.98 nW
-55 dBm	399 µV	3.16 nW
-56 dBm	355 µV	2.51 nW
-57 dBm	317 µV	2.00 nW
-58 dBm	282 µV	1.59 nW
-59 dBm	252 µV	1.26 nW
-60 dBm	224 µV	1.00 nW
-61 dBm	200 µV	794 pW
-62 dBm	178 µV	632 pW
-63 dBm	159 µV	500 pW
-64 dBm	141 µV	398 pW
-65 dBm	126 µV	316 pW
-66 dBm	112 µV	251 pW
-67 dBm	100 µV	200 pW
-68 dBm	89.1 µV	159 pW
-69 dBm	79.5 µV	126 pW

Correspondence Chart for Decibels, Volts and Watts
Table 2 (cont)

DECIBELS	VOLTS	WATTS
-70 dBm	70.9 µV	100 pW
-71 dBm	63.3 µV	79.4 pW
-72 dBm	56.3 µV	63.2 pW
-73 dBm	50.1 µV	50.0 pW
-74 dBm	44.7 µV	39.8 pW
-75 dBm	39.9 µV	31.6 pW
-76 dBm	35.5 µV	25.1 pW
-77 dBm	31.7 µV	20.0 pW
-78 dBm	28.2 µV	15.9 pW
-79 dBm	25.2 µV	12.6 pW
-80 dBm	22.4 µV	10.0 pW
-81 dBm	20.0 µV	7.94 pW
-82 dBm	17.8 µV	6.32 pW
-83 dBm	15.9 µV	5.00 pW
-84 dBm	14.1 µV	3.98 pW
-85 dBm	12.6 µV	3.16 pW
-86 dBm	11.2 µV	2.51 pW
-87 dBm	10.0 µV	2.00 pW
-88 dBm	8.91 µV	1.59 pW
-89 dBm	7.95 µV	1.26 pW

Correspondence Chart for Decibels, Volts and Watts
Table 2 (cont)

LOCALIZER

TONE DIFFERENCE VALUES				COURSE DEVIATION INDICATOR	
% MODULATION					
90 Hz	150 Hz	DDM	DECIBELS	DEFLECTION	μA
20.00	20.00	0	0	Centered	0
15.35	24.65	0.093	4.114	Standard	90
12.25	27.75	0.155	7.102	Full Scale	150
10.00	30.00	0.200	9.542	> Full Scale	194
0.00	40.00	0.4	Infinity	Full One Tone, Delete Other	387

NOTE: Standard CDI Deflection = 60% of Full Scale (Linear Movement).

NOTE: Deflections in μA apply to Indicators with Full Scale Deflection Current of 150 μA.

Correspondence Chart for 90 Hz and 150 Hz Tones (LOC)
Table 3

GLIDE SLOPE

TONE DIFFERENCE VALUES				COURSE DEVIATION INDICATOR	
% MODULATION					
90 Hz	150 Hz	DDM	DECIBELS	DEFLECTION	μA
40.00	40.00	0	0	Centered	0
35.45	44.55	0.091	1.988	Standard	78
31.25	48.75	0.175	3.622	Full Scale	150
20.00	60.00	0.400	9.542	> Full Scale	343
0.00	80.00	0.8	Infinity	Full One Tone, Delete Other	686

NOTE: Standard G/S Indicator Deflection = 53% of Full Scale (Linear Movement).

NOTE: Deflections in μA apply to Indicators with Full Scale Deflection Current of 150 μA.

Correspondence Chart for 90 Hz and 150 Hz Tones (G/S)
Table 4

SECTION 3 - SPECIFICATIONS

1. NAV-402AP-3 SPECIFICATIONS

NOTE: A 15 minute warm-up period is required for all specifications

1.1 RF OUTPUT

Output Level Range:	Continuously variable from -7 to -110 dBm
Output Level Accuracy:	±3 dB from -30 to -110 dBm
Output Frequency:	
MKR FIXED:	75 MHz
MKR VAR:	72 to 78 MHz in 25 kHz steps
VOR FIXED LO:	108 MHz
VOR FIXED HI:	112.8 MHz
VOR VAR:	107 to 120 MHz in 25 kHz steps
LOC FIXED:	108.1 MHz
LOC VAR:	107 to 120 MHz in 25 kHz steps
G/S FIXED LO:	329.6 MHz
G/S FIXED HI:	334.7 MHz
G/S VAR:	327 to 337 MHz in 50 kHz steps
COM FIXED:	126.9 MHz
COM 25 kHz:	118 to 156 MHz in 25 kHz steps
COM 8.33 kHz:	118 to 156 MHz in 8.33 kHz steps
Frequency Accuracy:	±3 ppm
Temperature Stability:	1 ppm
Aging:	1 ppm
Setability:	1 ppm
Harmonics:	≥15 dBc (Output Level -30 dBm)
Broadband Noise:	≥70 dBc at ±50 kHz (Output Level -30 dBm) 300 Hz Resolution Bandwidth, 10 Hz Video Filter
Auxiliary Localizer Transmitter:	
Output Level:	-18 dBm (typical) independent of Output Attenuator setting
Frequency:	108.1 and 110.5 MHz
Frequency Accuracy:	±0.005%

1.2 MARKER MODE

Marker Tone Frequency Accuracy:

1020 Hz:	±1%
400 Hz:	±1%
1300 Hz:	±1%
3000 Hz:	±1%

Marker Tone Demod Distortion
(9960 Hz Reference Level set to min):

1020 Hz:	≤2.5%
400 Hz:	≤2.5%
1300 Hz:	≤2.5%
3000 Hz:	≤2.5%

Modulation:

CAL:	95% AM ±5% for each tone
Variable:	3% to 96% AM
External CAL:	95% AM (typical) (10 Hz to 20 kHz, 5 Vp-p input)
External Variable:	3% to 96% AM (typical) (10 Hz to 20 kHz, 5 Vp-p input)

1.3 VOR MODE

VOR Tone Frequency Accuracy:	
30 Hz Reference:	±0.02%
30 Hz Variable:	±0.02%
9960 Hz:	±0.02%
1020 Hz:	±1%
VOR Tone Demod Distortion:	
30 Hz Variable:	≤2%
1020 Hz:	≤2.5%
AM Modulation:	
CAL:	30% AM ±2% for each tone
Variable:	3% to 55% AM
External CAL:	30% AM (typical) (10 Hz to 20 kHz, 5 Vp-p input)
External Variable:	3% to 55% AM (typical) (10 Hz to 20 kHz, 5 Vp-p input)
FM Modulation:	30 Hz Reference at 480 Hz (±25 Hz) Deviation on 9960 Hz
Bearing:	359.9 digitally derived courses in 0.1° increments. Accuracy ±0.1°

1.4 LOC MODE

LOC Tone Frequency Accuracy:

90 Hz:	±0.02%
150 Hz Variable:	±0.02%
1020 Hz:	±1%

LOC Tone Demod Distortion
(9960 Hz Reference Level set to min):

90 Hz:	≤2%
150 Hz:	≤2%
1020 Hz:	≤2.5%

Modulation:

CAL (90 Hz and 150 Hz):	20% AM ±2% for each tone
CAL (Audio Tones):	30% AM ±2% for each tone
Variable:	3% to 35% AM
External Mod (CAL):	30% AM (typical) (10 Hz to 20 kHz, 5 Vp-p input)
External Mod Variable:	3% to 55% AM (typical) (10 Hz to 20 kHz, 5 Vp-p input)
LOC DDM:	0.093, 0.155, and 0.200 DDM and Tone Delete
Accuracy:	±0.0013 DDM (±1.3 μA) ±0.0013 DDM (±7% of Setting) (At RF Output)
Variable DDM:	±0.4 DDM
Phase Shift:	90 and 150 Hz tones phase locked to 5 times VOR Bearing Select switch setting (refer to 1-3-1, Table 1)

1.5 G/S MODE

LOC Tone Frequency Accuracy:

90 Hz:	±0.02%
150 Hz Variable:	±0.02%

G/S Tone Demod Distortion
(9960 Hz Reference Level set to min):

90 Hz:	≤2%
150 Hz:	≤2%

Modulation:

CAL (90 Hz and 150 Hz):	40% AM ±2% for each tone
Variable:	3% to 75% AM
LOC DDM:	0.091, 0.175, and 0.40 DDM and Tone Delete
Accuracy:	±0.0024 DDM (±2.0 μA) (Tone Out) ±0.005 DDM (±5% of Setting) (At RF Output)
Variable DDM:	±0.8 DDM
Phase Shift:	90 and 150 Hz tones phase locked to 5 times VOR Bearing Select switch setting (refer to 1-3-1, Table 1)

1.6 COM MODE

COM Tone Frequency Accuracy:

1020 Hz:	±1%
400 Hz:	±1%
1300 Hz:	±1%
3000 Hz:	±1%

COM Tone Demod Distortion
(9960 Hz Reference Level set to min):

1020 Hz:	≤2.5%
400 Hz:	≤2.5%
1300 Hz:	≤2.5%
3000 Hz:	≤2.5%

Modulation:

CAL:	30% AM ±2% for each tone
Variable:	3% to 55% AM
External Mod (CAL):	30% AM (typical) (10 Hz to 20 kHz, 5 Vp-p input)
External Mod Variable:	3% to 55% AM (typical) (10 Hz to 20 kHz, 5 Vp-p input)

CAUTION: MAXIMUM INPUT POWER TO COUNTER IS LIMITED TO 250 mW OR +24 dBm. EXCEEDING THESE LIMITS MAY DAMAGE THE TEST SET.

1.7 EXTERNAL FREQUENCY COUNTER

Frequency Range:	
Hz, kHz:	1 to 10 MHz
kHz, MHz:	10 to 300 MHz
Resolution:	
Hz:	1 Hz
kHz (1 to 10 MHz Range):	10 Hz
kHz (10 to 300 MHz Range):	100 Hz
MHz:	1 kHz
Accuracy:	±0.002% (Typically ±0.0005%)
Sensitivity:	
10 MHz:	0.08 Vrms (-9 dBm)
200 MHz:	0.15 Vrms (-3 dBm)
300 MHz:	0.23 Vrms (0 dBm)
Impedance:	50 Ω AC terminated
Maximum Input Level:	≤250 mW (+24 dBm)

1.8 POWER METER

Range:	0 to 100 W, 0 to 10 W
Accuracy:	±3% full scale ±5% of reading
Duty Cycle:	
≤20 W:	Continuous
>20 W to 40 W:	5 minutes on, 50% Duty Cycle
>40 W to 80 W:	1 minute on, 20% Duty Cycle
>80 W to 100 W:	0.5 minute on, 10% Duty Cycle

1.9 BATTERY LEVEL MONITOR

Range:	0 to 30 V
Accuracy:	±5% of reading

1.10 BEARING MONITOR

Range:	±0.5° (0° at meter center)

1.11 BATTERY

Type:	2.0 AH NiCad
Duration:	≈ 1.5 Hours Continuous

1.12 AC POWER

Input Range:	100 to 120 VAC, 60 Hz 220 to 240 VAC, 50 Hz
Power Consumption:	38 W Maximum 28 W Nominal at 115 VAC 22 W Nominal at 230 VAC
Fuse Requirements:	
100 to 120 VAC:	1.0 A, 250 V, Type F
220 to 240 VAC:	0.5 A, 250 V, Type F
Mains Supply Voltage Fluctuations:	≤±10% of the nominal voltage
Transient Overvoltages:	According to Installation Category II

1.13 ENVIRONMENTAL

Use:	Pollution Degree 2
Altitude:	≤4000 meters (13,124 feet)
Temperature:	5° to 40°C (41°F to 104°F)
Relative Humidity:	≤80% for temperatures up to 31°C (88°F), decreasing linearly to 50% at 40°C (104°F)

SETTING ON VOR BEARING SELECT SWITCHES	150 Hz PHASE RELATIVE TO 90 Hz
000.0	0°
001.0	+5°
002.0	+10°
003.0	+15°
004.0	+20°
005.0	+25°
006.0	+30°
007.0	+35°
008.0	+40°
009.0	+45°
010.0	+50°
011.0	+55°
012.0	+60°
013.0	+65°
014.0	+70°
015.0	+75°
016.0	+80°
017.0	+85°
018.0	+90°
019.0	+95°
020.0	+100°
021.0	+105°
022.0	+110°
023.0	+115°
024.0	+120° or 0°

VOR Bearing Select Switches
Table 1

VOR BRG Switch Position	150 Hz Phase Relative to 90 Hz
000.0	0°
001.0	+5°
002.0	+10°
003.0	+15°
004.0	+20°
005.0	+25°
006.0	+30°
007.0	+35°
008.0	+40°
009.0	+45°
010.0	+50°
011.0	+55°
012.0	+60°
013.0	+65°
014.0	+70°
015.0	+75°
016.0	+80°
017.0	+85°
018.0	+90°
019.0	+95°
020.0	+100°
021.0	+105°
022.0	+110°
023.0	+115°
024.0	+120° or 0° *

NOTE: +120° has the same Phase Relationship as 0°; therefore, only 1° through 12° VOR BRG Switch positions are required.

90 Hz and 150 Hz Tones Variable Phase Relationships
Table 2

SECTION 4 - SHIPPING

1. SHIPPING TEST SETS

1.1 INFORMATION

Aeroflex Test Sets returned to factory for calibration, service or repair must be repackaged and shipped according to the following conditions:

AUTHORIZATION

Only return products to factory after first receiving authorization from Aeroflex Customer Service Department.

CONTACT: Aeroflex
Customer Service

Telephone: (800) 835-2350
FAX: (316) 524-2623
email: *service@aeroflex.com*

TAGGING TEST SETS

All Test Sets must be tagged with:

- Identification and address of owner
- Nature of service or repair required
- Model Number
- Serial Number

SHIPPING CONTAINERS

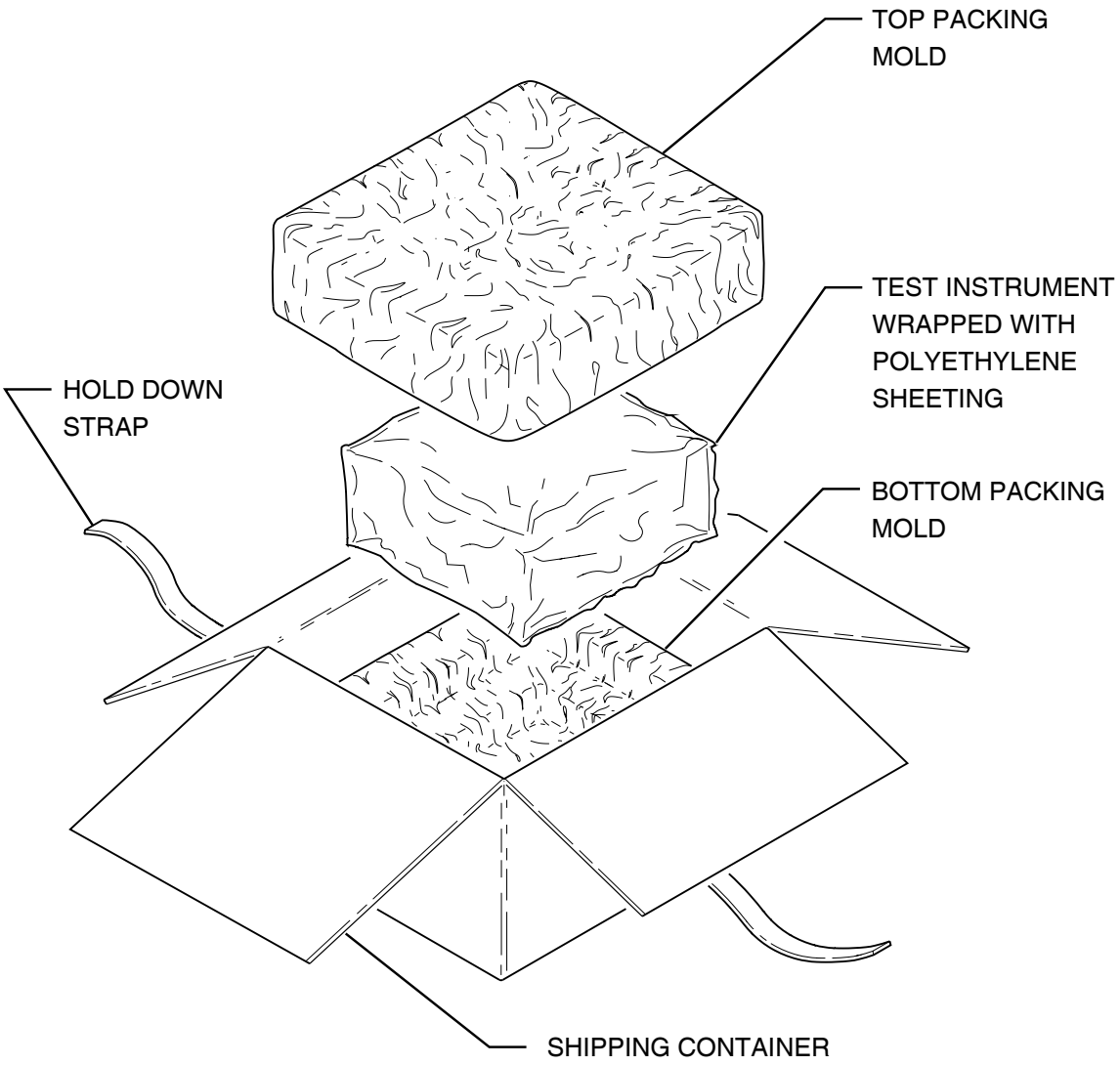
Test Sets must be repackaged in original shipping containers using Aeroflex packing molds. If original shipping containers and materials are unavailable, contact Aeroflex Customer Service for shipping instructions.

FREIGHT COSTS

All freight costs on non-warranty shipments are assumed by the customer. (See “Warranty Packet” for freight charge policy on warranty claims.)

1.2 REPACKING PROCEDURE

- Make sure bottom packing mold is seated on floor of shipping container.
- Carefully wrap Test Set with polyethylene sheeting to protect finish.
- Place Test Set into shipping container, making sure Test Set is securely seated in bottom packing mold.
- Place top packing mold over top of Test Set and press down until mold rests solidly in bottom packing mold.
- Close shipping container lids and seal with shipping tape or an industrial stapler. Tie all sides of container with break resistant rope, twine or equivalent.



Repacking Procedure
Figure 1

SECTION 5 - STORAGE

1. STORING TEST SETS

Perform the following storage precautions whenever the Test Set is stored for extended periods:

- Disconnect Test Set from any electrical power source.
- Disconnect and store ac power cable and other accessories with Test Set.
- Cover Test Set to prevent dust and debris from covering and entering Test Set.

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APPENDIX A - TABLE OF I/O CONNECTORS

CONNECTOR	TYPE	SIGNAL TYPE	INPUT/OUTPUT
AC IN	IEC320	ac Line Power	INPUT
RF OUT	BNC	RF	OUTPUT
COM XMTR IN	BNC	RF	INPUT
MOD IN/EXT FREQ CTR IN	BNC	RF/AUDIO	INPUT
NAV TONE OUT	BNC	AUDIO	OUTPUT
SIG GEN DEMOD	BNC	AUDIO	OUTPUT
PWR MON DEMOD	BNC	AUDIO	OUTPUT

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APPENDIX B - METRIC/BRITISH IMPERIAL CONVERSION TABLE WITH NAUTICAL DISTANCE CONVERSIONS

TO CONVERT:	INTO:	MULTIPLY BY:	TO CONVERT:	INTO:	MULTIPLY BY:
cm	feet	0.03281	meters	feet	3.281
cm	inches	0.3937	meters	inches	39.37
feet	cm	30.48	m/sec	ft/sec	3.281
feet	meters	0.3048	m/sec	km/hr	3.6
ft/sec	km/hr	1.097	m/sec	miles/hr	2.237
ft/sec	knots	0.5921	miles	feet	5280
ft/sec	miles/hr	0.6818	miles	km	1.609
ft/sec^2	cm/sec^2	30.48	miles	meters	1609
ft/sec^2	m/sec^2	0.3048	miles	nmi	0.8684
grams	ounces	0.03527	miles/hr	ft/sec	1.467
inches	cm	2.54	miles/hr	km/hr	1.609
kg	pounds	2.205	miles/hr	knots	0.8684
kg/cm^2	psi	0.0703	nmi	feet	6080.27
km	feet	3281	nmi	km	1.8532
km	miles	0.6214	nmi	meters	1853.2
km	nmi	0.5396	nmi	miles	1.1516
km/hr	ft/sec	0.9113	ounces	grams	28.34953
km/hr	knots	0.5396	pounds	kg	0.4536
km/hr	miles/hr	0.6214	psi	kg/cm^2	0.0703
knots	ft/sec	1.689	100 ft	km	3.048
knots	km/hr	1.8532	100 ft	miles	1.894
knots	miles/hr	1.1516	100 ft	nmi	1.645

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APPENDIX C - ABBREVIATIONS

A	
A	Amperes
AC, ac	Alternating Current
approx	Approximate
AVG	Average
B	
BAT	Battery
BRG	Bearing
C	
C	Celsius or Centigrade
CAL	Calibration
ccw	Counterclockwise
cm	Centimeter
COMM	Communication
CTR	Center
CW	Continuous Wave
cw	Clockwise
D	
dB	Decibel
dBm	Decibel above one Milliwatt
dBw	Decibel relative to one Watt
DDM	Difference in Depth of Modulation
E	
EXT	External
F	
FCC	Federal Communications Commission
FM	Frequency Modulation
FREQ	Frequency
ft	Feet
G	
GEN	Generate
G/S	Glideslope
H	
HF	High Frequency
HI	High
Hz	Hertz
I	
Ident	Identification
ILS	Instrument Landing System
IN	Input
I/O	Input/Output
K	
kg	Kilogram
kHz	Kilohertz
kW	Kilowatts
L	
lbs.	Pounds
LO	Local Oscillator
LOC	Localizer
LOC DDM	Localizer Difference in Depth of Modulation
M	
MKR	Marker
MHz	Megahertz
MOD	Modulation
mV	Millivolts
mW	Milliwatts
N	
NAV	Navigation
nW	Nanowatts
O	
OUT	Output
P	
pW	Picowatts
PWR	Power
R	
RF	Radio Frequency
U	
UUT	Unit Under Test
V	
V	Volt
VAC	Volts Alternating Current
VAR	Variable
Vdc	Volts Direct Current
VHF	Very High Frequency
VOR	VHF Omnidirectional Range
VP-P	Volts Peak-to-Peak
Vrms	Volts Root-Mean-Square

W

W	Watts
w/o	Without

X

XMTR	Transmitter
XTL	Crystal

µA	Microamperes
µV	Microvolts
µW	Microwatts

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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven, customer-focused.